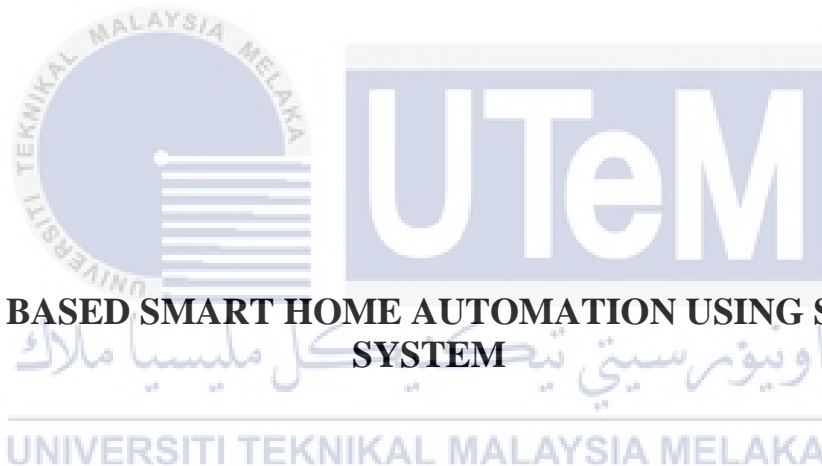




**Faculty of Electrical and Electronic Engineering Technology**



**IOT- BASED SMART HOME AUTOMATION USING SOLAR  
SYSTEM**

**MOHAMMAD NUR SYUKRI BIN ABDUL HALIM**

**Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics)  
with Honours**

**2021**

# **IOT- BASED SMART HOME AUTOMATION USING SOLAR SYSTEM**

**MOHAMMAD NUR SYUKRI BIN ABDUL HALIM**

**A project report submitted  
in partial fulfilment of the requirements for the degree of  
Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics)  
with Honours**



**Faculty of Electrical and Electronic Engineering Technology**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**2021**

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PROJEK SARJANA MUDA II**

Tajuk Projek: IoT-BASED SMART HOME AUTOMATION USING SOLAR SYSTEM

Sesi Pengajian: 2021 / 2022

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I declare that this project report entitled “IoT-Based Smart Home Automation using Solar System” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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I hereby declare that I have checked this project report, and, in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours.

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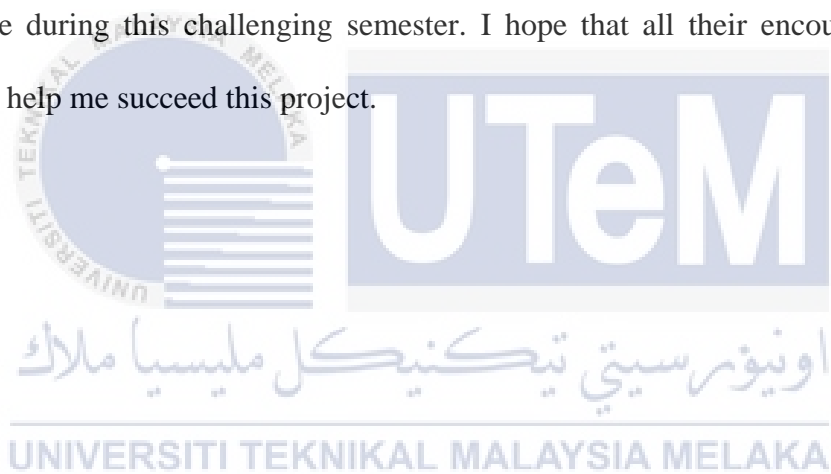
Supervisor Name : TS. SULAIMAN BIN SABIKAN .....

Date : 6 / 2 / 2022 .....



## DEDICATION

I appreciate, respect, and am grateful to both of my parents for their love, encouragement, support, and sacrifice throughout my life. I would not have attained this level without their dedication and motivation. My deepest gratitude also goes to my brothers and sisters, who always support and advise me in all I do in life. Many thanks to all the professors, especially my supervisor, Ts. Sulaiman Bin Saikan has taught and led me throughout my studies and during this Bachelor 2 Final Project. I want to thank all my friends who have always been there for me during this challenging semester. I hope that all their encouragement and support will help me succeed this project.



## ABSTRACT

IoT -based smart home automation systems are widely used nowadays. Therefore, the role of IoT is to facilitate the quality of daily human life, and one of the applications that use this IoT system is home automation. The main objective of the research is to design solar-based power sources for smart home automation controllers. In addition, the next objective is to integrate smart home automation with home electrical appliances. The final objective is to develop a mobile application to control and monitor home electrical appliances. The main power supply is from a solar panel and the second power supply is a grid power supply. The microcontroller receives the wireless input and passes it to a relay, which can turn on or off the required load. The expected result of this project is to ensure that the microcontroller can be turned on for 24 hours by using two power supplies, namely the main power supply and secondary power supply. This is a project that can control home electrical appliances can remotely use a smartphone application. The project is to reduce electricity consumption from the grid and more to renewable energy sources.

## ***ABSTRAK***

Sistem automasi rumah pintar berasaskan IoT digunakan secara meluas pada masa kini. Oleh itu, peranan IoT adalah untuk memudahkan kualiti kehidupan manusia seharian, dan salah satu aplikasi yang menggunakan sistem IoT ini ialah automasi rumah. Objektif utama penyelidikan adalah untuk mereka bentuk sumber kuasa berasaskan solar untuk pengawal automasi rumah pintar. Di samping itu, objektif seterusnya adalah untuk menggabungkan automasi rumah pintar dengan peralatan elektrik rumah. Objektif terakhir adalah mengembangkan aplikasi mudah alih untuk kawalan dan pemantauan peralatan elektrik di rumah. Bekalan kuasa utama adalah dari panel solar dan bekalan kuasa kedua adalah bekalan kuasa grid. Mikrokontroler akan menerima input tanpa wayar dan meneruskannya ke relay, yang dapat menghidupkan atau mematikan beban yang diperlukan. Hasil yang diharapkan dari projek ini adalah memastikan mikrokontroler dapat dihidupkan selama 24 jam dengan menggunakan dua bekalan kuasa, iaitu bekalan kuasa utama dan bekalan kuasa sekunder. Ini adalah projek yang boleh mengawal perkakas elektrik rumah boleh dari jauh menggunakan aplikasi telefon pintar. Projek ini dijalankan adalah untuk mengurangkan penggunaan tenaga elektrik dari grid dan lebih kepada sumber kuasa tenaga yang boleh diperbaharu



## ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude and appreciation to the lecturers who have helped me succeed in Bachelor's Degree Project 2. I really appreciate all the sacrifices and knowledge to my mentor that has given to me. I also thank you for giving me the opportunity to become a mentee under Ts. Sulaiman bin Sabikan for her encouragement, knowledgeable ideas and opinions, time consideration, spirit and being the guidance through the time of completing my Bachelor's Degree Project (BDP). My thanks and appreciation also dedicate to both of my panels, Ts. Mohd Razali bin Mohamad Sapiee as Panel 1 and Ts Dr. aliza binti Che Amran as panel 2 that willing to observe my BDP, giving the positive comments which helps me to gain knowledge and improve the project in this period of time.



## TABLE OF CONTENTS

|  | <b>PAGE</b> |
|--|-------------|
| <b>DECLARATION</b>                                   |             |
| <b>APPROVAL</b>                                      |             |
| <b>DEDICATIONS</b>                                   |             |
| <b>ABSTRACT</b>                                      | <b>i</b>    |
| <b>ABSTRAK</b>                                       | <b>ii</b>   |
| <b>ACKNOWLEDGEMENTS</b>                              | <b>iii</b>  |
| <b>TABLE OF CONTENTS</b>                             | <b>iv</b>   |
| <b>LIST OF TABLES</b>                                | <b>vi</b>   |
| <b>LIST OF FIGURES</b>                               | <b>vii</b>  |
| <b>LIST OF SYMBOLS</b>                               | <b>ix</b>   |
| <b>LIST OF ABBREVIATIONS</b>                         | <b>x</b>    |
| <b>LIST OF APPENDICES</b>                            | <b>xi</b>   |
| <b>CHAPTER 1 INTRODUCTION</b>                        | <b>1</b>    |
| 1.1 Background                                       | 1           |
| 1.2 Problem Statement                                | 2           |
| 1.3 Project Objective                                | 2           |
| 1.4 Scope of Project                                 | 3           |
| <b>CHAPTER 2 LITERATURE REVIEW</b>                   | <b>4</b>    |
| 2.1 Overview   | 4           |
| 2.2 Smart Home Automation System                     | 4           |
| 2.3 Solar System Technology                          | 5           |
| 2.3.1 On-Grid Solar System                           | 6           |
| 2.3.2 Off-Grid Solar System                          | 7           |
| 2.3.3 Hybrid Solar System                            | 8           |
| 2.4 Internet of Things (IoT)                         | 10          |
| 2.5 Related Previous Research                        | 11          |
| 2.5.1 Smart Home Automation System Previous Research | 11          |
| 2.5.2 Solar System Technology Previous Research      | 13          |
| 2.5.3 Internet of Things (IoT) Previous Research     | 14          |
| 2.6 Summary  | 16          |
| <b>CHAPTER 3 METHODOLOGY</b>                         | <b>17</b>   |
| 3.1 Overview   | 17          |
| 3.2 Research Methodology Flowchart                   | 17          |

|                   |  |           |
|-------------------|--|-----------|
| 3.3               | Milestone 1: Development Smart Home Automation Controller Power Supply Based on Solar System | 21        |
| 3.3.1             | Smart Home Automation Design Architecture  | 22        |
| 3.3.2             | Software Development   | 23        |
| 3.3.2.1           | Integrated Programming Software  | 23        |
| 3.3.2.2           | Circuit Simulation Software  | 24        |
| 3.3.3             | Hardware Development   | 26        |
| 3.3.3.1           | Solar Panel  | 26        |
| 3.3.3.2           | Solar Charger Controller   | 27        |
| 3.3.3.3           | Microcontroller  | 27        |
| 3.3.3.4           | Relay Module   | 29        |
| 3.4               | Milestone 2: Integration Smart Home Automation with Home Appliances                          | 30        |
| 3.5               | Milestone 3: Smartphone Application for Control and Monitoring                               | 31        |
| 3.6               | Summary  | 32        |
| <b>CHAPTER 4</b>  | <b>RESULTS AND DISCUSSIONS</b>   | <b>33</b> |
| 4.1               | Overview   | 33        |
| 4.2               | Controller System for Smart Home   | 33        |
| 4.2.1             | Data Analysis  | 34        |
| 4.2.2             | Controller System Smart Home Analysis  | 40        |
| 4.3               | Running Load Inverter 3000W  | 41        |
| 4.3.1             | Inverter working   | 41        |
| 4.3.2             | Data Analysis  | 43        |
| 4.4               | Smart Home Control System with Supply Source from Solar                                      | 45        |
| 4.4.1             | Running the Solar System with Load USB 5V  | 46        |
| 4.4.1.1           | Measurement Output Voltage with Load USB 5V  | 46        |
| 4.4.1.2           | Data Analysis for Load USB 5V  | 48        |
| 4.4.2             | Running the Solar System with Load 12V inverter  | 48        |
| 4.4.2.1           | Measurement Output Voltage with Load 12V Inverter  | 48        |
| 4.4.2.2           | Data Analysis for Load 12V   | 49        |
| 4.5               | Home Automation System Performance   | 50        |
| 4.5.1             | Analysis of Voltage Sensor   | 50        |
| 4.6               | Internet of Things (IoT) System  | 52        |
| 4.6.1             | Analysis of ESP-32 NodeMCU Module  | 52        |
| 4.6.2             | Connection of ESP-32 NodeMCU Module with server  | 52        |
| 4.6.3             | Notification system using ESP8266 Wi-Fi Module   | 54        |
| 4.7               | Discussion   | 55        |
| <b>CHAPTER 5</b>  | <b>CONCLUSION AND RECOMMENDATIONS</b>  | <b>57</b> |
| 5.1               | Overview   | 57        |
| 5.2               | Recommendation Future Works  | 58        |
| <b>REFERENCES</b> |  | <b>59</b> |
| <b>APPENDICES</b> |  | <b>63</b> |

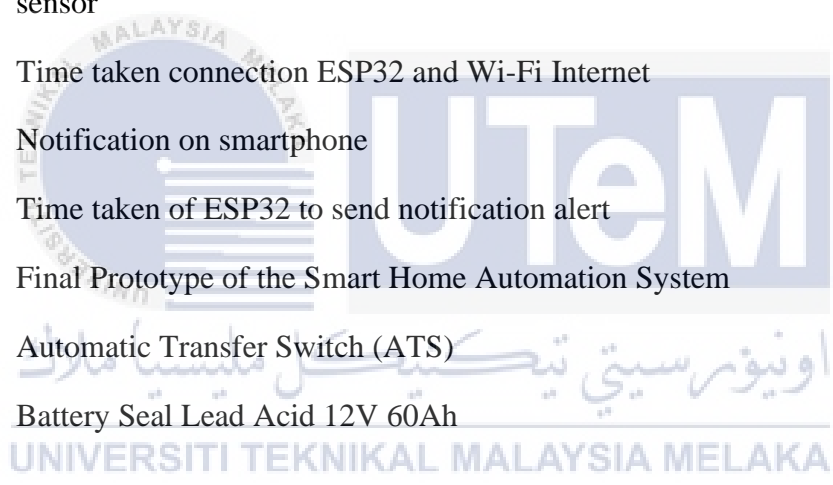
## LIST OF TABLES

| <b>TABLE</b> | <b>TITLE</b>  | <b>PAGE</b> |
|--------------|---|-------------|
| Table 3.1:   | Features of NodeMCU ESP32                                       | 28          |
| Table 3.2:   | Pinout Description for 4-channel Relay Module                   | 30          |
| Table 4.1:   | Functionality Controller System                                 | 35          |
| Table 4.2:   | Functionality Inverter with Router and Modem                    | 43          |
| Table 4.3:   | Data taken of Output Voltage without Solar Panel                | 44          |
| Table 4.4:   | Data taken of Output Voltage with Solar Panel and Output USB 5V | 46          |
| Table 4.5:   | Data taken of Output Voltage with Solar Panel and Output 12V    | 48          |
| Table 4.6:   | Data taken of Output Voltage Sensor                             | 50          |
| Table 4.7:   | Data taken of Connectivity between ESP32 and Internet Wi-Fi     | 53          |
| Table 4.8:   | Data taken of attempt to send battery voltage                   | 54          |

## LIST OF FIGURES

| <b>FIGURE</b> | <b>TITLE</b>   | <b>PAGE</b> |
|---------------|--|-------------|
| Figure 2.1:   | Configuration On-grid solar system (David Tan, 2011)                                   | 7           |
| Figure 2.2:   | Configuration on off-grid solar system. (David Tan, 2011)                              | 8           |
| Figure 2.3:   | Basic Hybrid Solar System.   | 9           |
| Figure 3.1:   | Flowchart for Overall Project Development  | 20          |
| Figure 3.2:   | The illustration power system from solar panel to Smart Home Automation                | 21          |
| Figure 3.3:   | Block diagram for IoT-Based Smart Home Automation Using Solar System                   | 22          |
| Figure 3.4:   | Arduino (IDE) software   | 24          |
| Figure 3.5:   | Proteus 8 Professional software.   | 25          |
| Figure 3.8:   | Solar Panel 12V  | 26          |
| Figure 3.9:   | Solar Charge Controller 12V  | 27          |
| Figure 3.10:  | NodeMCU ESP32  | 28          |
| Figure 3.11:  | NodeMCU ESP32 Pinout   | 29          |
| Figure 3.13:  | 4-channel Relay Module   | 30          |
| Figure 3.14:  | The illustration connection between Smart Home Automation and home appliances.         | 31          |
| Figure 3.15:  | The interface that will be created on the Mobile Application for Smart Home Automation | 32          |
| Figure 4.1:   | Circuit Controller system for Smart Home Automation in Control Panel                   | 34          |
| Figure 4.2:   | Interfaces on Blynk Apps when the switch 1 and switch 2 is ON                          | 36          |
| Figure 4.3:   | Display at LCD when Wi-Fi connected to ESP32, switch 1 and switch 2 is ON.             | 37          |
| Figure 4.4:   | Interfaces on Blynk Apps when the switch 1 and switch 2 is OFF                         | 38          |

|  |    |
|--|----|
| Figure 4.5: Display at LCD when Wi-Fi connected to ESP32, switch 1 and switch 2 is OFF.        | 39 |
| Figure 4.6: Notification on smartphone through Blynk Apps.                                     | 40 |
| Figure 4.7: Connection between inverter to solar charge controller and battery                 | 42 |
| Figure 4.8: Arrangement and connection between inverter to solar charge controller and battery | 42 |
| Figure 4.9: Output Voltage on Battery and Display Solar Charge Controller                      | 45 |
| Figure 4.10: Output Voltage Battery on with Load USB 5V  | 47 |
| Figure 4.11: Output Voltage Battery on with Load 12V   | 49 |
| Figure 4.12: Comparison Output Voltage Battery using multimeter and voltage sensor             | 51 |
| Figure 4.13: Time taken connection ESP32 and Wi-Fi Internet                                    | 53 |
| Figure 4.14: Notification on smartphone  | 54 |
| Figure 4.15: Time taken of ESP32 to send notification alert                                    | 55 |
| Figure 4.16: Final Prototype of the Smart Home Automation System                               | 56 |
| Figure 5.1: Automatic Transfer Switch (ATS)  | 58 |
| Figure 5.2: Battery Seal Lead Acid 12V 60Ah  | 58 |



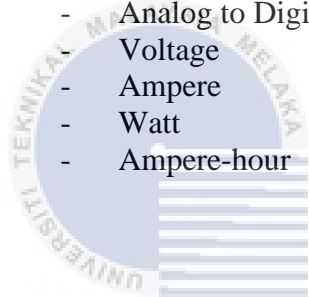
## LIST OF SYMBOLS

|     |   |            |
|-----|---|------------|
| $E$ | - | Voltage    |
| $I$ | - | Current    |
| $R$ | - | Resistance |
| $W$ | - | Power      |
| $s$ | - | Second     |



## LIST OF ABBREVIATIONS

|       |   |   |
|-------|---|---|
| IoT   | - | Internet of Things                      |
| PV    | - | Photovoltaic                            |
| Wi-Fi | - | Wireless Fidelity                       |
| GSM   | - | Global System for Mobile Communications |
| LAN   | - | Local Area Network                      |
| IDE   | - | Integrated Development Environment      |
| PCB   | - | Printed Circuit Board                   |
| AC    | - | Alternating Current                     |
| DC    | - | Direct Current                          |
| LCD   | - | Liquid Crystal Display                  |
| Led   | - | Light-emitting Diode                    |
| SLA   | - | Seal Lead Acid                          |
| USB   | - | Universal Serial Bus                    |
| ADC   | - | Analog to Digital Conversion            |
| V     | - | Voltage                                 |
| A     | - | Ampere                                  |
| W     | - | Watt                                    |
| Ah    | - | Ampere-hour                             |



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## LIST OF APPENDICES

| APPENDIX   | TITLE                         | PAGE |
|------------|-------------------------------|------|
| Appendix A | Ghantt Chart                  | 63   |
| Appendix B | ESP32 NodeMCU Microcontroller | 64   |
| Appendix C | Voltage Sensor                | 66   |
| Appendix D | Solar Charge Controller       | 68   |
| Appendix E | Completed Coding              | 69   |



# CHAPTER 1

## INTRODUCTION

### 1.1 Background

Nowadays, people are increasingly relying on technology that simplifies their daily work. Smart home automation systems are a great technology to facilitate human work in the home. Smart home automation is the automatic control of electronic devices in your home. The device is connected to the Internet, which allows it to be operated remotely. With home automation, devices can trigger each other, so you do not have to operate them manually via an app or voice assistant. For example, you can turn on the lights on the table until they go off when you usually sleep, or you can ask your thermostat to turn on the air conditioner about an hour before you go back to work, so you do not have to go back to a crowded house. Home automation makes life easier and can even save you money on heating, cooling, and electricity bills. Home automation can also lead to greater security with Internet of Things (IoT) devices such as cameras and security systems.

The Internet of things (IoT) is a system of interconnected computing devices, mechanical and digital machines, objects, animals, or people equipped with a unique identifier (UID) and the ability to transfer data over a network without the need for a human to human or human to computer interaction. IoT is one of the most widely used technologies nowadays. IoT must be associated with an internet connection capable of remotely controlling equipment, such as appliances in the house. In addition, the project uses energy sources from solar energy that provide power to microcontrollers that control the function

of appliances in the home. Solar technology converts sunlight into electrical energy through photovoltaic (PV) panels or mirrors that concentrate sunlight. This energy source can be used to generate electricity or stored in batteries or heat storage. The project underway is IoT-based Smart Home Automation using Solar Systems. This project is very suitable for seniors.

## **1.2 Problem Statement**

In this sophisticated era, the rising economy and the cost of living caused people to get busier every day. Some people work to save money to achieve their life goals. There are also others who do jobs to finance daily living such as rented houses, electricity bills, bank loans during school hours, and finance the children's schooling. As a result, people are increasingly busy with their daily routines and only have short breaks on weekends. Of course, they do not have time to clean the house and do the housework. But, more importantly, people always forget to turn off the light switches and fans at home. Some people also forget to turn off electrical appliances in the house such as rice cookers, and televisions. This will cause their cost of living to increase to pay electricity bills and people do not want that to happen always.

## **1.3 Project Objective**

For this project to be succeeded, the objectives which need to be achieved are:

- a) To design power supply based on solar system for smart home automation controller.
- b) To integrate smart home automation with home electrical appliances.
- c) To develop mobile application for control and monitor home electrical appliances.

## 1.4 Scope of Project

To avoid any uncertainty of this project due to some limitations and constraints, the scope of the project is defined as follows:

- a) Create a Smart Home Automation Controller System powered by a solar system where the ESP32 will be controlling several of electronic component such as relay.
- b) Users can control the electrical appliance at home and can still have to access the internet caused the power supply for Wi-Fi router is from the solar system.
- c) The solar system cannot be run if the weather is cloudy throughout the week.



## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Overview

This chapter is to review an IoT-based Home Automation system that ESP32 will act as a microcontroller that will communicate to the other components and the solar system that will be the main power supply for this system. The detailed data and the specification for the system will be explained later within the supporting evidence from the previous journal research. All the source of the data was mostly from the journal, articles and the case report and it is based on the scope of the project that will be explained later.

#### 2.2 Smart Home Automation System

Smart Home Automation has grown in popularity over the last few decades, and it significantly improves one's comfort and quality of life. Home automation is the automation of a building using a microcontroller and numerous other components, referred to as an intelligent home or bright house. Refer to research (Malik and Bodwade, 2017) home automation is the process of remotely monitoring and controlling household appliances. A smart home is one that has been outfitted with specific features that allow residents to control or programme a variety of automated home electronic gadgets. For instance, a homeowner on vacation can arm a home security system, manage temperature gauges, turn on or off appliances, adjust lights, programme a home theatre or entertainment system, and do a variety of other functions (Shahriyar *et al.*, 2008). However, it may contain components of home security, like access control and alarm systems.

Smartphone applications control and monitor home automation systems using many different types of wireless communications such as Wi-Fi, Bluetooth, and GSM (Palaniappan *et al.*, 2015). However, these techniques and their features are studied and compared to choose their technology options to build their home automation systems. Smartphone applications connect the network connection, so the users can use the application to adjust system settings on a smartphone device. Various types of home automation systems offer a wide range of functions and services.

### 2.3 Solar System Technology

Solar energy is the process of converting sunlight to electricity. Sunlight may be directly turned to power with photovoltaics (PV) (Ahsan, 2015). Based on an article from (Szabó, 2017), the phrase "photovoltaic" is derived from the Greek word "phos," which represents light, and from the unit of electromotive force, the "volt." The photovoltaic effect was discovered by Alexandre-Edmond Becquerel, a French physicist (1820-1891). Solar panels can be used for various purposes, including remote cabin power systems, telecommunications equipment, remote sensing, and of course, power generation using residential and commercial solar power systems. Based on the article (Adejuyigbe *et al.*, 2013), the photovoltaic generator (solar panel), mounting frame, energy storage device, inverter, charge controller, and wiring system are all included in the system.

Solar panels are an inexpensive technique for generating electricity for a wide variety of applications. Living off the grid is the most obvious option. Living off-grid means living in a place that is not connected to the primary power grid—ideal for secluded homes and cottages. No more exorbitant fees for installing electricity pylons and cables from the nearest main network access point. A solar power system is theoretically cheaper and, with

proper maintenance, can produce energy for up to three decades. Aside from the fact that solar panels make it possible to live off the grid, perhaps the most significant benefit of using solar energy is a clean, renewable energy source. It has become more critical that we do everything we can to reduce the pressure in our atmosphere by emitting greenhouse gases. Solar modules have no moving parts and are low maintenance. They are robustly built and can be appropriately maintained for decades in use.

Based on (Maddileti, 2020) all solar energy systems function based on the same basic principles. DC power can then be stored in batteries or converted by a solar inverter into AC power that can be used to run household appliances. Depending on the type of system, excess solar energy can be put into the electrical grid to earn credit or stored in various battery storage systems. Thus, there are three main types of solar system energy:

- i) On-Grid Solar system
- ii) Off-Grid Solar System
- iii) Hybrid Solar System.

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### **2.3.1 On-Grid Solar System**

According to the article Types of Solar Photovoltaic System by (Franklin, 2017), grid-connected photovoltaic systems are among the most rapidly expanding types of PV systems. On-grid or grid-connected solar systems are the most common and most widely used by households and businesses. A grid-connected system consists of a solar array (connected photovoltaic modules) and an inverter that converts DC electricity to alternating current. The electrical energy generated by the solar system is sent to the utility company during the day. Therefore, the owner of the photovoltaic system can save money by

developing and transferring more electrical energy to the utility than the owner consumes during days when the photovoltaic system is not transmitting power, such as at night or on cloudy days. Besides that refer to an article by (Maddileti, 2020), electricity can be drawn from the power grid at night or when the solar energy system is not functioning correctly. Also, based on the same article (Maddileti, 2020), the disadvantage of grid solar energy is that in certain weather conditions or when there are problems with the power grid, we cannot store the electricity for immediate consumption, which is inconvenient for this system. Figure 2.1 shows the example of a configuration On-grid solar system.

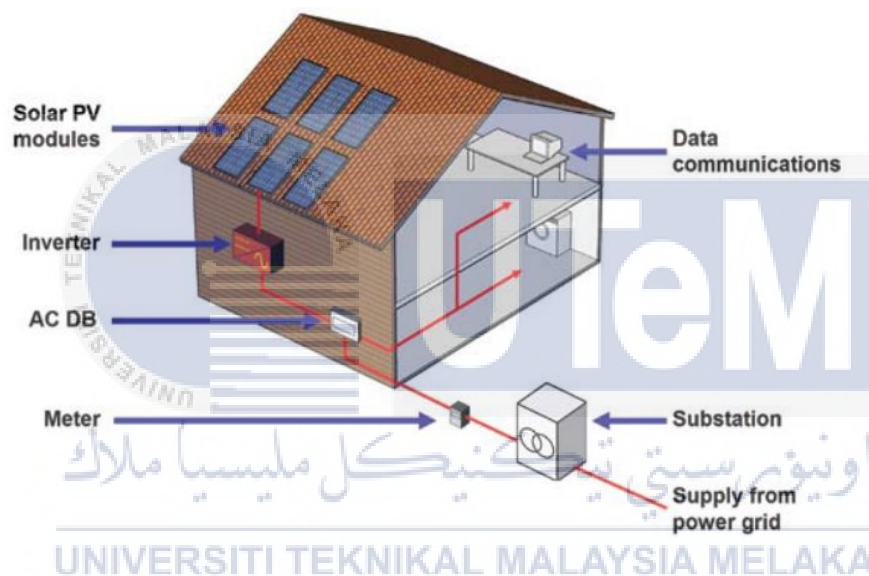


Figure 2.1: Configuration On-grid solar system (David Tan, 2011)

### 2.3.2 Off-Grid Solar System

An off-grid solar photovoltaic system is a photovoltaic system that operates independently of the grid. In other words, it is not grid-connected. They are also highly beneficial in applications such as streetlights, street signage, and traffic signals where the grid is nearby, but a stand-alone or off-grid solar PV system is more convenient. Stand-alone systems generate and consume energy in the exact location and do not interact with the primary grid in any way (Mohanty *et al.*, 2016). Since an off-grid system is not connected